REMARKS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1-17 have been rejected under 35 U.S.C. § 112, second paragraph, as being vague and indefinite, and Claims 1-17 have been rejected under 35 U.S.C. § 103 as being unpatentable over the Tool and Manufacturing Engineer's Handbook (hereinafter the *Engineer's Handbook*) in view of Mori and Nomura.

Considering first then the Examiner's objection to the specification and drawings, it is to be noted that core 24 referred to in the specification should instead read core 14. Accordingly, corrections have been made to the specification to reflect this insofar as reference number 14 correctly appears in the drawings, withdrawal of this objection to the specification and drawings is believed to be in order and the same is hereby respectfully requested.

Considering next then the rejection of Claims 1-17 under 35 U.S.C. § 112, second paragraph, it is to be noted that the claims have now been amended for proper antecedent basis by including the corrections requested by the Examiner.

Considering next then the rejection of Claims 1-17 under 35 U.S.C. § 103 as being unpatentable over the *Engineer's Handbook* in view of Mori and Nomura, it is noted that while the Examiner has cited the *Engineer's Handbook* as teaching a core diameter as presently claimed that it is known that web thickness is a variable that controls the strength of the drill and thrust force needed, there is no teaching or disclosure in any of the above-noted references of the limitation of the core diameter of the hole forming tool as being in a range of 0.38D to 0.42D wherein D is a cutting edge diameter of the hole forming tool. The importance of this limitation is emphasized in numerous portions of the present application,

including, for example, at page 3, lines 22-29, page 7, lines 14-23 and page 9, lines 18-20. In this regard, having a core diameter in the range indicated above ensures rigidity of the main body and that the space inside the chip discharging groove 6,6 is sufficient. As further noted, when the core diameter is smaller than 0.38D, the flexural rigidity of the tool be insufficient and when the core diameter is larger than 0.42, the space inside the chip discharging grooves will be too small so that the chips will accumulate therein.

In view of the foregoing, the importance of core diameter ratio claimed will be readily understood. In this regard, it is noted that the *Engineer's Handbook* does not teach this limitation and instead only discusses web thickness at page 9-15 and pages 9-42, 43 (and illustrates the same in Figure 9-26) which shows that the web thickness differs from core diameter ratio claimed and instead makes reference to a chisel thickness as explained at page 9-43. Because the chisel edges are non-cutting portions of drill points, the web thickness is made as thin as possible, consistent with adequate structural strength. The approximate web thickness is near the point of the drills as presented in Table 9-9. It is noted, however, that the web thickness is, as illustrated in Figure 9-26, the distance between the two drill points and thus differs from the core diameter 14 illustrated in Figure 3 of the present application, and as discussed at page 7 of the application as being the diameter between the middle of land portions 10, 10. In this regard it is further noted that Mori takes a web ratio as 15-23% (i.e., the ratio of the diameter of the web to drill diameter, as discussed at column 1, lines 50-68 which is also outside Applicants' claimed range and which measures a different dimension than that referred to in the present application). In view of this, it is submitted that since corresponding limitations regarding the core diameter have been added to each of independent Claims 1, 6, 7, 16 and 17 all such claims now merit indication of allowability. In view of the limitations set forth and each of the claims dependent from such independent

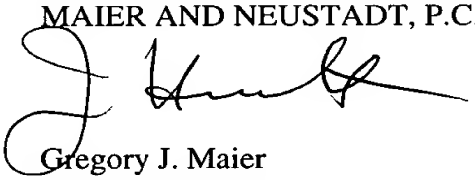
claims, it is submitted that such dependent claims also merit indication of allowability.

Applicants further note that independent Claims 18-22 have been added which correspond with Claims 1, 6, 7, 16, and 17, respectively, which have been amended to more broadly claim the present invention as including the core diameter ranges mentioned above, it is submitted that each of Claims 18-22 also merits indication of allowability.

In view of the foregoing, an early and favorable Office Action is believed to be in order and the same is hereby respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER AND NEUSTADT, P.C.



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IN THE SPECIFICATION

Page 2, please replace the paragraph numbered [0005] as follows:

When, for example, finishing processing is to be performed after the hole forming process, a hole formed by the above-described drills for hard steels will be a primary hole. Accordingly, in addition to the maintenance of the tool life, high cutting accuracy is also required. The above-described drills, however, are designed merely for increasing the rigidity thereof by decreasing the helix angle [ref] of the chip discharging grooves and by increasing the core diameter. Although such a construction reduces the risk of causing fracture of the cutting edges or breakage of the drills, there is a disadvantage in that the cutting force is increased and the sharpness of the cutting edges is degraded. As a result, the cutting accuracy is degraded.

Page 3, please replace the paragraph numbered [0014] as follows:

When the core diameter is smaller than 0.38D, the flexural rigidity of the tool will be insufficient, and when the core diameter is larger than [0.420] 0.42D, the space inside the chip discharging grooves will be too small so that the chips will [clump] accumulate therein.

Page 5, please replace the paragraph numbered [0031] as follows:

Figs. 6a-6f are [is a] schematic representations showing the results of a second test, in which examples of the present invention and comparative examples were compated.

Page 7, please replace the paragraph numbered [0042] as follows:

As shown in FIG. 1 and FIG. 3, the land portions 10 and 10 are separated by the pair of chip discharging grooves 6, 6. A diameter of a core [24] 14 in the middle of the land portions 10 and 10 is in the range of 0.38D to 0.42D, in which D is the cutting edge diameter representing the distance between the peripheral ends of the cutting edges 8, 8. When the core diameter is smaller than 0.38D, the flexural rigidity of the main body 2 will be reduced. When the core diameter is larger than 0.42D, the depth of the chip discharging grooves 6, 6 will be small and the space therein will be insufficient, so that the chips will clump inside the chip discharging grooves 6, 6, increasing the cutting force. As a result, fracture and wearing of the cutting edges 8 and 8 will occur. Accordingly, there will be problems in that the cutting accuracy will be degraded and the tool life will be reduced in either case.

Page 12, please replace the paragraph numbered [0063] as follows:

With respect to each of types A and D, three samples were used in this test. The results of the test are shown in Figs. 6a-6f.

Page 12, please replace the paragraph numbered [0064] as follows:

First, holes were formed under conditions in which the feed was fixed to 0.10 mm/rev and the cutting speed was icnreased from 1 to 20 m/min, and the amounts of oversizing in the formed holes were measured (see [the upper section in the column labeled "oversized" in] Fig. 6a). Next, holes were formed under conditions in which the cutting speed was fixed to 20 m/min, the feed was increased to 0.10 mm/rev, and the amounts of oversizing in the formed holes were measured (see [the lower section in the column labeled "oversize" in] Fig. 6d).

Page 12, please replace the paragraph numbered [0065] as follows:

The degree of variation in the amounts of oversizing in the holes formed by the

samples of type D was larger compared to the holes formed by the samples of type A. In the case in which the feed was fixed, the sample of type D broke when the cutting speed was 20 m/min, as is understood from [the upper section in] Figs. 6a-6d. In the case in which the cutting speed was fixed, the sample of type D broke when the fee was 0.10 mm/rev, as is understood from [the lower section in] Figs 6c-6f.

Page 12 and 13, please replace the paragraph numbered [0066] as follows:

First, holes were formed under conditions in which the feed was fixed to 0.10 mm/rev and the cutting speed was increased from 1 to 20 m/min, and surface roughnesses of the formed holes were measured (see [the upper section in the column labeled "surface roughness"in] Fig.6b). Next, holes were formed under conditions in which the cutting speed was fixed to 20 m/min, the feed was increased to 0.10 mm/rev, and the surface roughnesses of the fored holes were measured (see [the lower section in the column labeled "surface roughness" in] Fig. 6e).

Page 13, please replace the paragraph numbered [0067] as follows:

The degree of variation in the surface roughnesses of the holes formed by the samples of type D was larger compared to the holes formed by the samples of type A. In the case in which the feed was fixed, the sample of type D broke when the cutting speed was 20 m/min, as is understood from [the upper section in] Figs. 6a-6c. In the case in which the cutting speed was fixed, the sample of type D broke when the feed was 0.10 mm/rev, as is understood from [the lower section in] Figs. 6d-6f.

Page 13, please replace the paragraph numbered [0068] as follows:

First, holes were formed under conditions in which the feed was fixed to 0.10 mm/rev and the cutting speed was increased from 1 to 24 m/min, and the circularity of each of the formed holes were measured (see [the upper section in the column labeled "circularity" in]

Fig. 6c). Next, holes were formed under conditions in which the cutting speed was fixed to 20 m/min and the feed was increased to 0.10 mm/rev, and the circularities of the formed holes were measured (see [the lower section in the column labeled "circularity" in] Fig. 6f).

Page 13, please replace the paragraph number [0069] as follows:

The circularities of the holes formed by the samples of type D were larger compared to the holes formed by the samples of type A. In the case in which the feed was fixed, the sample of type D broke when the cutting speed was 20 m/min, as is understood from [the upper section in] Figs. 6a-6c. In the case in which the cutting speed was fixed, the sample of type D broke when the feed was 0.10 mm/rev, as is understood from [the lower section in] Figs. 6d-6f. In, a third test, the variation in the amounts of abrasion in the flank face and the variation in the amounts of oversizing were examined.

Please delete page 16 in its entirety.

IN THE CLAIMS

1. (Amended) A hole forming tool which rotates around a rotational axis, comprising: one or more chip discharging grooves which are helically formed around [the] a rotational axis in [the] an exterior surface of said hole forming tool, said chip discharging grooves having an inner surface; and

one or more cutting edges which are formed along ridge lines between inner surfaces of said chip discharging grooves, which are facing the rotating direction, and flank faces formed at an end [o£] of said hole forming tool,

wherein a radial rake angle of said cutting edges is set to a negative [valve] value in [the] a range of -5° to -10°, [wherein] a point angle thereof is in [the] a range of 125° to 135°, [and wherein] a groove width ratio thereof is in [the] a range of 0.9 to 1.1 and wherein a core diameter thereof is in the range of 0.38D to 0.42D, wherein D comprises a cutting edge diameter of said hole forming tool.

2. (Canceled).

3. (Amended) A hole forming tool according to claim 1, wherein a helix angle of said chip discharging grooves is in [the] a range of 5° to 15°.

4. (Amended) A hole forming tool which rotates around a rotational axis, comprising:

one or more chip discharging grooves which are helically formed around [the] a rotational axis in [the] an exterior surface of said hole forming tool; and

one or more cutting edges which are formed along ridge lines between inner surfaces of said chip discharging grooves, which [are facing the] face a rotating direction of said hole forming tool, and flank faces formed at an end of said hole forming tool,

wherein a radial rake angle of said one or more chip discharging cutting edges is set to a negative value in the range of -5° to -10°, [wherein] a point angle thereof is in [the] a range

of 125° to 135°, and [wherein] a core diameter thereof is in [the] a range of 0.38D to 0.42D, in which D is a cutting edge diameter of said hole forming tool.

5. (Amended) A hole forming tool according to claim 4, wherein a helix angle of said chip discharging grooves is in [the] a range of 5° to 15°.

6. (Amended) A hole forming tool which rotates around a rotational axis, comprising:

one or more chip discharging grooves which are helically formed around [the]a rotational axis in [the] an exterior surface of said hole forming tool; and one or more cutting edges which are formed along ridge lines between inner surfaces of said chip discharging grooves, which [are facing the] face a rotating direction of said hole forming tool, and flank faces formed at an end of said hole forming tool,

wherein a radial rake angle of said one or more chip discharging cutting edges is set to a negative value in [the] a range of -5° to -10°, [wherein] a point angle is in [the] range of 125° to 135°, [and wherein] a helix angle of said chip discharging grooves is in [the] a range of 5° to 15° and wherein a core diameter thereof is in the range of 0.38D to 0.42D, wherein D comprises a cutting edge diameter of said hole forming tool.

7. (Amended) A hole forming tool which rotates around a rotational axis, comprising:

one or more chip discharging grooves which are helically formed around [the] a rotational axis in [the] an exterior surface of said hole forming tool; and

one or more cutting edges which are formed along ridge lines between inner surfaces of said chip discharging grooves, which [are facing the] a rotating direction, and flank faces formed at an end of said hole forming tool,

wherein a radial rake angle of said one or more chip discharging cutting edges is set to a negative value in [the I] a range of -5° to -10°, wherein a point angle thereof is in [the] a range of 125° to 135°, and wherein at least parts thereof including said cutting edges

comprise a cemented carbide and an average particle diameter of WC, comprised of said cemented carbide, is in [the] a range of 0.1 to 1.0μm and wherein a core diameter thereof is in a range of 0.38D to 0.42D, wherein D comprises a cutting edge diameter of said hole forming tool.

8. (Amended) A hole forming tool according to one of claim 7, wherein a groove width ratio is in [the] a range of 0.9 to 1.1.

9. (Canceled).

10. (Amended) A hole forming tool according to one of claim 7, wherein a helix angle of said chip discharging grooves is in [the] a range of 5° to 15°.

11. (Amended) A hole forming tool which rotates around a rotational axis, comprising:

one or more chip discharging grooves which are helically formed around [the] a rotational axis in the exterior surface of said hole forming tool; and

one or more cutting edges which are formed along ridge lines between inner surfaces of said chip discharging grooves, which [are facing the] face a rotating direction of said hole forming tool, and flank faces formed at an end of said hole forming tool,

wherein a radial rake angle of said one or more chip discharging cutting edges is set to a negative value in [the] a range of -5° to -10°, wherein a point angle thereof is in [the] a range of 125° to 135°, [and wherein.] at least a part thereof including said chip discharging grooves of said hole forming tool is coated with a layer constructed of a hard material and wherein a core diameter thereof is in a range of 0.38D to 0.42D, wherein D comprises a cutting edge diameter of said hole forming tool.

12. (Amended) A hole forming tool according to one of claim 11, wherein a groove width ratio is in [the] a range of 0.9 to 1.1.

13. (Canceled).

14. (Amended) A hole forming tool according to one of claim 11, wherein a helix angle of said chip discharging grooves is in [the] a range of 5° to 15°.

15. (Amended) A hole forming tool according to claim 1, wherein the main body of said hole forming tool is constructed of a cemented carbide which comprises 10±2 wt % Co, 0.65±0.25 wt % Cr, WC for [the] a balance thereof, and inevitable impurities.

16. (Amended) A hole forming tool which rotates around a rotational axis, comprising:

one or more chip discharging grooves which are helically formed around [the] a rotational axis in [the] an exterior surface of said hole forming tool; and

one or more cutting edges which are formed along ridge lines between inner surfaces of said chip discharging grooves, which are facing [the] a rotating direction, and flank faces formed at an end of said [hale] hole forming tool,

wherein a radial rake angle of said one or more chip discharging cutting edges is set to a negative value in the range of -5° to -10°, [wherein] a point angle is in [the] a range of 125° to 135°, [and wherein] the main body of said hole forming tool is constructed of a cemented carbide which comprises 10±2 wt % Co, 0.65±0.25 wt % Cr, WC for [the] a balance thereof, and inevitable impurities and wherein a core diameter thereof is in a range of 0.38D to 0.42D, wherein D comprises a cutting edge diameter of said hole forming tool.

17. (Amended) A method of constructing a hole forming tool which is rotatable about a rotational axis, comprising:

helically forming one or more chip discharging grooves around the rotational axis and in [the] an exterior surface of said hole forming tool; and

forming one or more cutting edges along ridge lines between inner surfaces of said

chip discharging grooves, which face the rotational direction, and flank faces formed at an end of said hole forming tool, and

setting a radial rake angle of said cutting edges to a negative value in [the] a range of -5° to -10°, wherein a point angle is in [the] a range of 125° to 135°, and wherein a groove width ratio is in a range of 0.9 to 1.1; and

forming a core diameter of the whole forming tool so as to be in a range of 0.38D to 0.42D wherein D is a cutting edge diameter of said hole forming tool.

18-22. (New).

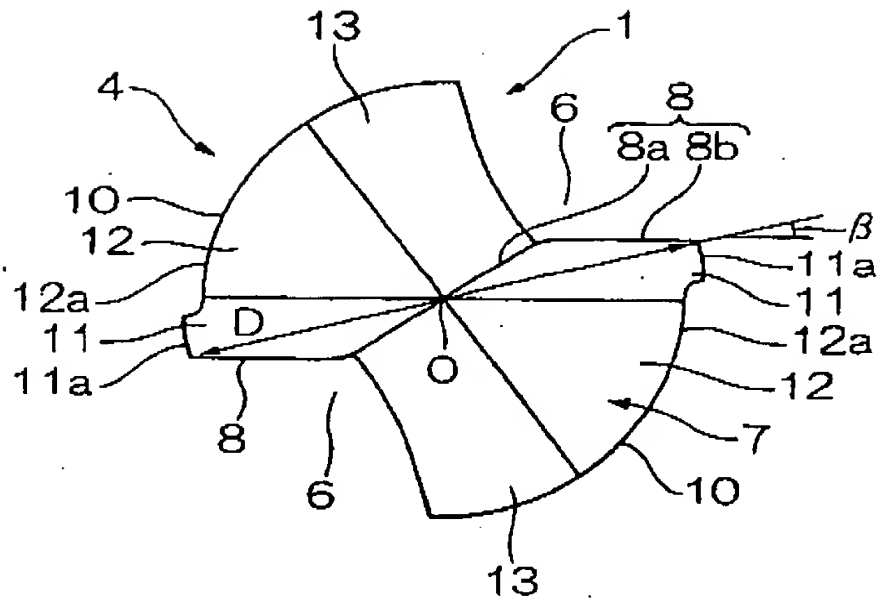

FIG. 1

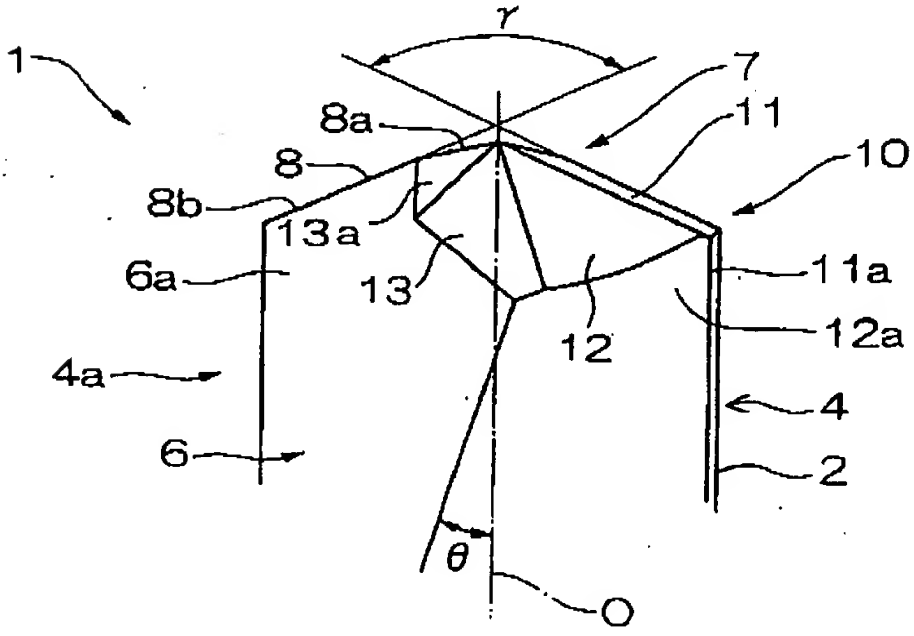

FIG.2

FIG. 5

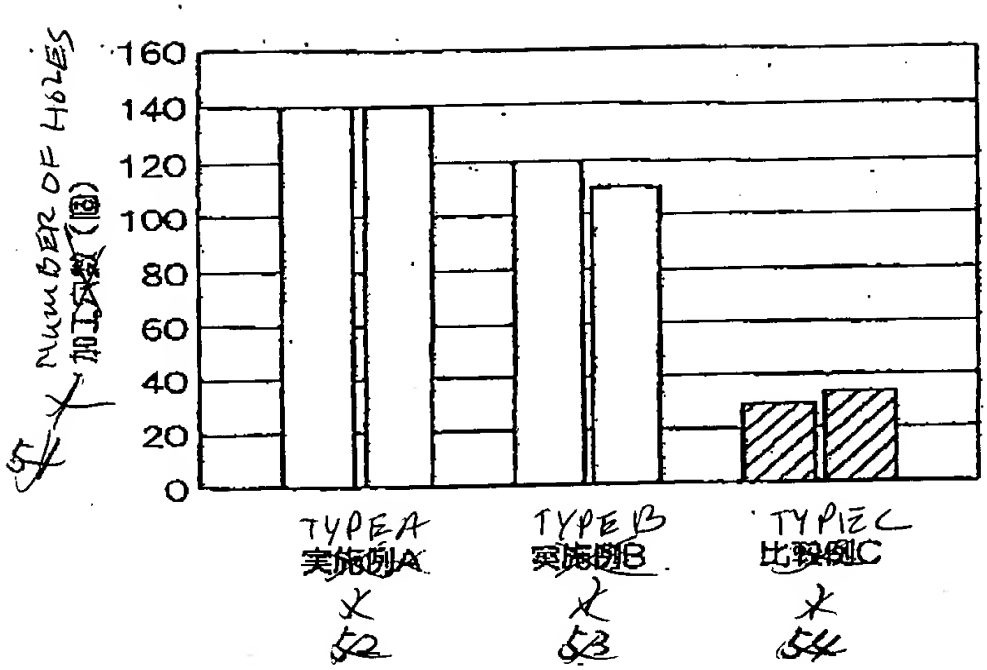

FIG. 6

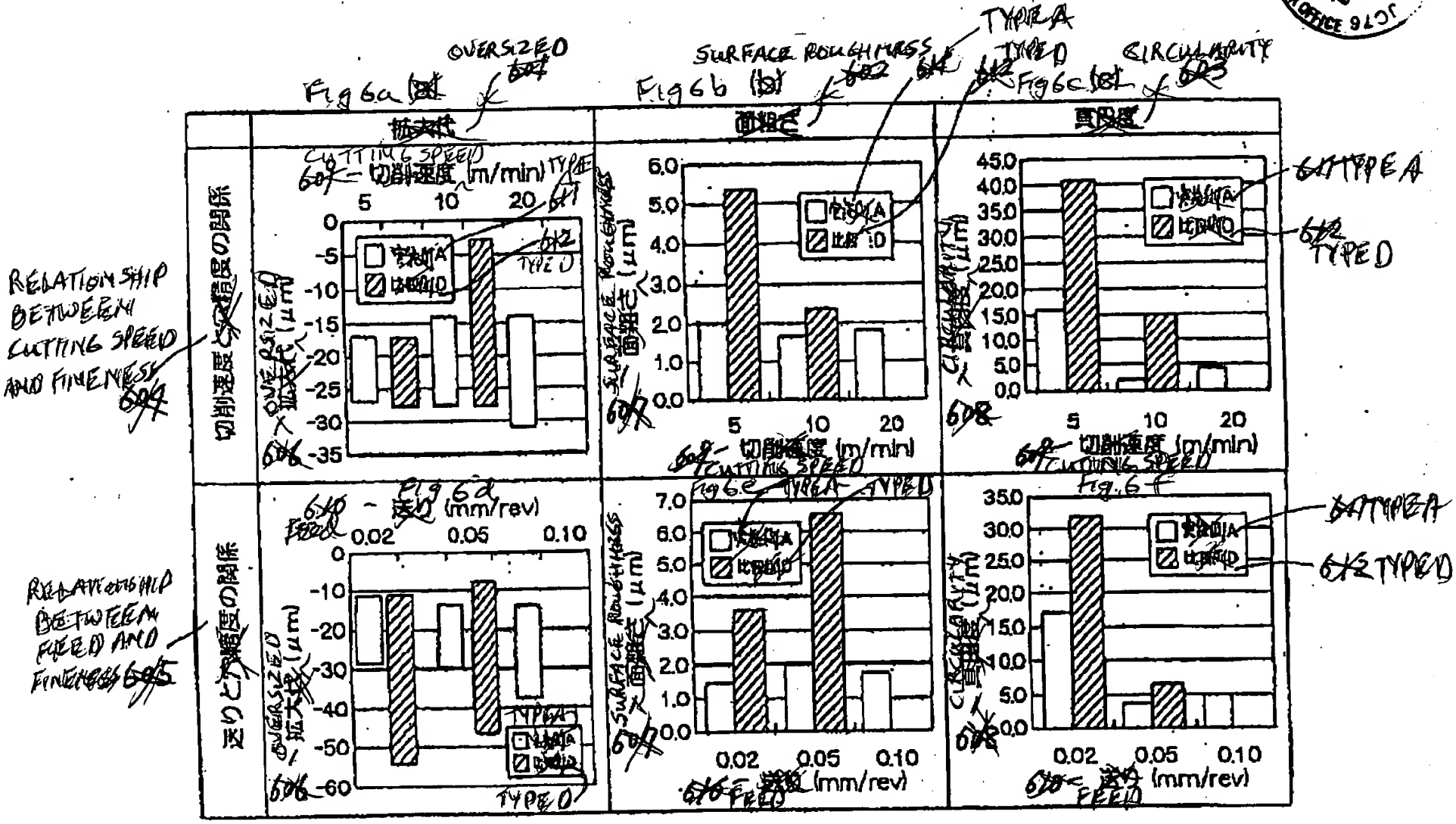
RELATIONSHIP BETWEEN CUTTING SPEED AND FINENESS
RELATIONSHIP BETWEEN FEED AND FINENESS
CUTTING SPEED (m/min)
FEED (mm/rev)
OVERSIZED (μm)
SURFACE ROUGHNESS (μm)
CIRCULARITY (μm)
TYPE A
TYPE D
5
10
20
0.02
0.05
0.10
0
-5
-10
-15
-20
-25
-30
-35
-40
-50
-60
6.0
5.0
4.0
3.0
2.0
1.0
0.0
7.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0

FIG. 7A

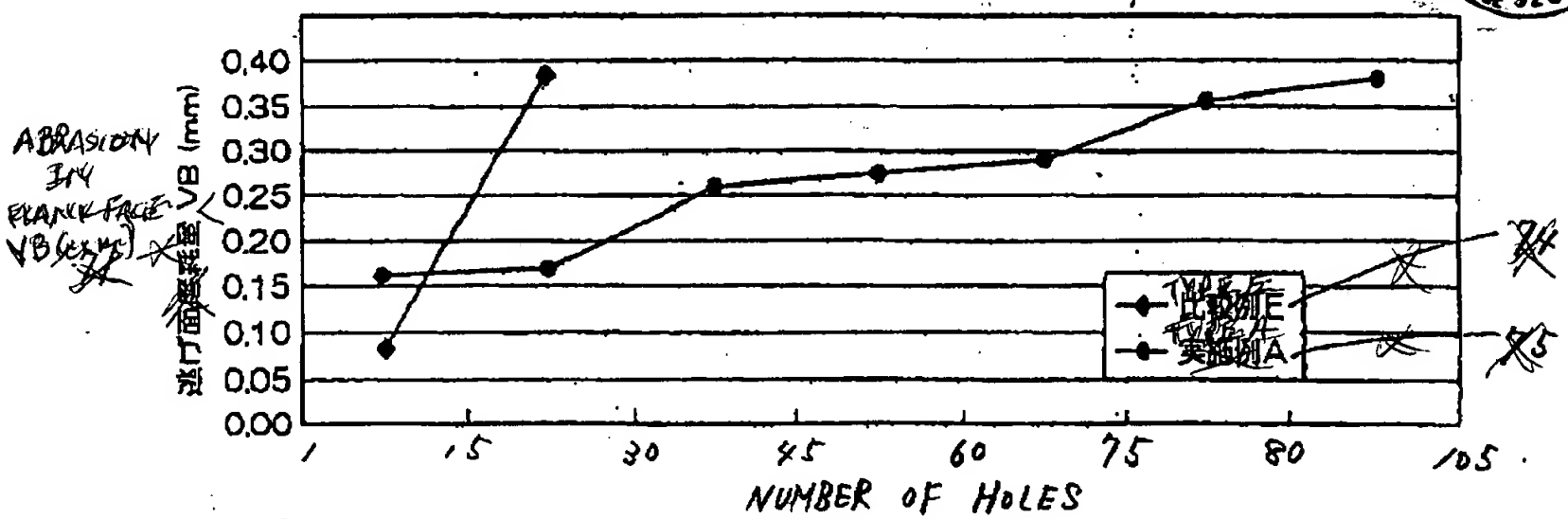

FIG. 7B